COST PROXY MODEL

CONDUIT ($ PER DUCT-FOOT) - FRC 4C
FOR 0.0 KFT TO 9.0 KFT

DENSITY	NORMAL	MED-DIF (ROCK-S)	HIGH-DIF (ROCK-H)	WATER
0-10	12.25	17.20	22.70	22.70
11-50	14.25	20.25	25.05	25.05
51-150	17.95	24.48	30.28	30.28
151-500	18.45	25.95	33.45	33.45
501-2000	13.92	21.15	28.90	28.90
2001-5000	9.80	15.56	21.96	21.96
5001+	7.59	12.59	18.59	18.59

NOTE: The reduction in the cost per duct-foot in the three highest density zones reflects the requirement of more ducts which share the trenching cost.

ASSUMPTIONS

1) The above investments per duct foot were developed using the "A Cost" and "B Cost" from the PLAN/ESM cost deck and the number of ducts that would typically be required in each density zone and providing a spare maintenance duct, ducts for fiber, and air pipe.

2) "A Cost" includes :
- engineering labor
- inspection labor
- travel time
- set-up time
- inplace cost of underground vaults (typical size 8 1/2 x 4 1/2 x 6 1/2) spaced at 600 feet
- cut & replace @ $10/ft (added to each density zone by estimated % of occurrence)

3) "B Cost" includes :
- material cost of ducts
- labor for placement of ducts

4) modified "A Cost" by density zone for :
- material spotting becomes more difficult and costly as the density of the work area increases
- substructure congestion increases with density and causes delays and changes
- heavier traffic in denser areas increases the required lane controls and work area protection
- frequency of street crossings that increases the amount of cutting and repaving required as well as restricting the length of trench that can be opened at one time
- work hour restrictions are usually imposed in denser areas primarily do to commuter traffic

CONDUIT ($ PER DUCT-FOOT) - FRC 4C

FOR 0.0 KFT TO 9.0 KFT

FACTORS WERE ESTIMATED FOR EACH DENSITY ZONE AND TERRAIN TO REFLECT THE CONDITIONS LISTED IN ASSUMPTION # 4 AND APPLIED TO THE "A COST". THE "B COST" WAS ADDED TO GET THE TOTAL INVESTMENT PER TRENCH-FOOT WHICH WAS DIVIDED BY THE NUMBER OF DUCTS MINUS ONE MAINTENANCE DUCT TO DETERMINE THE INVESTMENT / DUCT-FOOT.

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	NORMAL INVEST. /DUCT-FT (H=G/A-1)
0-10	3	22.00	2.30	0.80	17.60	6.90	24.50	**12.25**
11-50	3	24.00	2.30	0.90	21.60	6.90	28.50	**14.25**
51-150	3	29.00	2.30	1.00	29.00	6.90	35.90	**17.95**
151-500	3	30.00	2.30	1.00	30.00	6.90	36.90	**18.45**
501-2000	4	31.00	2.30	1.05	32.55	9.20	41.75	**13.92**
2001-5000	6	32.00	2.30	1.10	35.20	13.80	49.00	**9.80**
5001+	9	32.00	2.30	1.25	40.00	20.70	60.70	**7.59**

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	MED-DIF INVEST. /DUCT-FT (H=G/A-1)
0-10	3	22.00	2.30	1.25	27.50	6.90	34.40	**17.20**
11-50	3	24.00	2.30	1.40	33.60	6.90	40.50	**20.25**
51-150	3	29.00	2.30	1.45	42.05	6.90	48.95	**24.48**
151-500	3	30.00	2.30	1.50	45.00	6.90	51.90	**25.95**
501-2000	4	31.00	2.30	1.75	54.25	9.20	63.45	**21.15**
2001-5000	6	32.00	2.30	2.00	64.00	13.80	77.80	**15.56**
5001+	9	32.00	2.30	2.50	80.00	20.70	100.70	**12.59**

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	HIGH-DIF INVEST. /DUCT-FT (H=G/A-1)
0-10	3	22.00	2.30	1.75	38.50	6.90	45.40	**22.70**
11-50	3	24.00	2.30	1.80	43.20	6.90	50.10	**25.05**
51-150	3	29.00	2.30	1.85	53.65	6.90	60.55	**30.28**
151-500	3	30.00	2.30	2.00	60.00	6.90	66.90	**33.45**
501-2000	4	31.00	2.30	2.50	77.50	9.20	86.70	**28.90**
2001-5000	6	32.00	2.30	3.00	96.00	13.80	109.80	**21.96**
5001+	9	32.00	2.30	4.00	128.00	20.70	148.70	**18.59**

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	WATER INVEST. /DUCT-FT (H=G/A-1)
0-10	3	22.00	2.30	1.75	38.50	6.90	45.40	**22.70**
11-50	3	24.00	2.30	1.80	43.20	6.90	50.10	**25.05**
51-150	3	29.00	2.30	1.85	53.65	6.90	60.55	**30.28**
151-500	3	30.00	2.30	2.00	60.00	6.90	66.90	**33.45**
501-2000	4	31.00	2.30	2.50	77 50	9.20	86.70	**28.90**
2001-5000	6	32.00	2.30	3.00	96.00	13.80	109.80	**21.96**

5001+	9	32.00	2.30	4.00	128.00	20.70	148.70	**18.59**

SAMPLE CALCULATION
OF $ PER DUCT-FOOT
FOR "NORMAL TERRAIN - DENSITY 5000+

(A)	"A COST"	$22.00	(PER TRENCH FOOT)
(B)	CUT & REPLACE PAVEMENT	+ $10.00	(PER TRENCH FOOT)
(C)	SUB-TOTAL	$32.00	(PER TRENCH FOOT)
(D)	MODIFYING FACTOR	x 1.25	
(E=CxD)	TRENCHING COST ($32.00 x 1.25)	**$40.00**	(PER TRENCH FOOT)
(F)	"B COST"	$2.30	(PER DUCT-FOOT)
(G)	NUMBER OF DUCTS	x 9	
(H=FxG)	DUCT COST (9 x $2.30)	**$20.70**	(PER TRENCH FOOT)
(I=E+H)	TOTAL CONDUIT COST ($40.00+$20.70)	**$60.70**	(PER TRENCH FOOT)
(J)	USABLE DUCTS (9 - 1) (ONE DUCT MUST REMAIN SPARE FOR MAINTENANCE)	8	
(K=I/J)	COST PER DUCT-FOOT	**$7.59**	

4C - CONDUIT ($ PER DUCT-FOOT)
FOR 9.0 KFT AND LONGER

DENSITY	NORMAL	MED-DIF (ROCK-S)	HIGH-DIF (ROCK-H)	WATER
0-10	15.10	22.30	30.30	30.30
11-50	18.50	27.50	34.70	34.70
51-150	25.30	35.65	44.85	44.85
151-500	26.30	38.30	50.30	50.30
501-2000	15.43	24.18	33.55	33.55
2001-5000	16.60	28.30	41.30	41.30
5001+	18.55	34.80	54.30	54.30

NOTE: The reduction in the cost per duct-foot in the three highest density zones is caused by the increase in the number of ducts required, therefore trenching costs are spread over more ducts.

ASSUMPTIONS

1) The above investments per duct foot were developed using the "A Cost" and "B Cost" from the PLAN cost deck and the number of ducts that would typically be required in each density zone.

2) "A Cost" includes :
- engineering labor
- inspection labor
- travel time
- set-up time
- inplace cost of underground vaults (typical size 8 1/2 x 4 1/2 x 6 1/2) spaced at 600 feet
- cut & replace @ $10/ft (added to each density zone by estimated % of occurrence)

3) "B Cost" includes :
- material cost of ducts
- labor for placement of ducts

4) modified "A Cost" by density zone for :
- material spotting becomes more difficult and costly as the density of the work area increases
- substructure congestion increases with density and causes delays and changes
- heavier traffic in denser areas increases the required lane controls and work area protection
- frequency of street crossings that increases the amount of cutting and repaving required as well as restricting the length of trench that can be opened at one time
- work hour restrictions are usually imposed in denser areas primarily do to commuter traffic

CONDUIT ($ PER DUCT-FOOT) - FRC 4C

FOR 9.0 KFT AND LONGER

FACTORS WERE ESTIMATED FOR EACH DENSITY ZONE AND TERRAIN TO REFLECT THE CONDITIONS LISTED IN ASSUMPTION # 4 AND APPLIED TO THE "A COST". THE "B COST" WAS ADDED TO GET THE TOTAL INVESTMENT PER TRENCH-FOOT WHICH WAS DIVIDED BY THE NUMBER OF DUCTS. THE "A COST" REFLECT ADJUSTMENT FOR 1500 FOOT SPLICE VAULT SPACING.

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	NORMAL INVEST. /DUCT-FT (H=G/A)
0-10	1	16.00	2.30	0.80	12.80	2.30	15.10	**15.10**
11-50	1	18.00	2.30	0.90	16.20	2.30	18.50	**18.50**
51-150	1	23.00	2.30	1.00	23.00	2.30	25.30	**25.30**
151-500	1	24.00	2.30	1.00	24.00	2.30	26.30	**26.30**
501-2000	2	25.00	2.30	1.05	26.25	4.60	30.85	**15.43**
2001-5000	2	26.00	2.30	1.10	28.60	4.60	33.20	**16.60**
5001+	2	26.00	2.30	1.25	32.50	4.60	37.10	**18.55**

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	MED-DIF INVEST. /DUCT-FT (H=G/A)
0-10	1	16.00	2.30	1.25	20.00	2.30	22.30	**22.30**
11-50	1	18.00	2.30	1.40	25.20	2.30	27.50	**27.50**
51-150	1	23.00	2.30	1.45	33.35	2.30	35.65	**35.65**
151-500	1	24.00	2.30	1.50	36.00	2.30	38.30	**38.30**
501-2000	2	25.00	2.30	1.75	43.75	4.60	48.35	**24.18**
2001-5000	2	26.00	2.30	2.00	52.00	4.60	56.60	**28.30**
5001+	2	26.00	2.30	2.50	65.00	4.60	69.60	**34.80**

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	HIGH-DIF INVEST. /DUCT-FT (H=G/A)
0-10	1	16.00	2.30	1.75	28.00	2.30	30.30	**30.30**
11-50	1	18.00	2.30	1.80	32.40	2.30	34.70	**34.70**
51-150	1	23.00	2.30	1.85	42.55	2.30	44.85	**44.85**
151-500	1	24.00	2.30	2.00	48.00	2.30	50.30	**50.30**
501-2000	2	25.00	2.30	2.50	62.50	4.60	67.10	**33.55**
2001-5000	2	26.00	2.30	3.00	78.00	4.60	82.60	**41.30**
5001+	2	26.00	2.30	4.00	104.00	4.60	108.60	**54.30**

DENSITY	REQUIRED DUCTS (A)	A COST (B)	B COST (C)	MOD FACT (D)	MODIFIED A COST (E=BxD)	TOTAL B COST (F=AxC)	TOTAL INVEST TRENCH-FT (G=E+F)	WATER INVEST. /DUCT-FT (H=G/A)
0-10	1	16.00	2.30	1.75	28.00	2.30	30.30	**30.30**
11-50	1	18.00	2.30	1.80	32.40	2.30	34.70	**34.70**
51-150	1	23.00	2.30	1.85	42.55	2.30	44.85	**44.85**
151-500	1	24.00	2.30	2.00	48.00	2.30	50.30	**50.30**
501-2000	2	25.00	2.30	2.50	62.50	4.60	67.10	**33.55**
2001-5000	2	26.00	2.30	3.00	78.00	4.60	82.60	**41.30**

5001+	2	26.00	2.30	4.00	104.00	4.60	108.60	$\boxed{54.30}$

COST PROXY MODEL

CONDUIT ($ PER DUCT-FOOT) - FRC 4C
DISTRIBUTION

DENSITY	ALL TERRAINS
0-10	9.50
11-50	9.50
51-150	9.50
151-500	9.50
501-2000	9.50
2001-5000	9.50
5001+	9.50

ASSUMPTIONS

1) The above investments per duct foot were developed as follows :

$5.00	Trench
$2.00	1 - 4" duct
$2.50	Handholes
$9.50	

2) Typical subdivisions with buried or underground plant would not be constructed in areas with other than "normal" digging conditions. This avoids inflating the distribution conduit costs because a CBG has other than NORMAL terrain digging conditions.

3) The $5.00 trenching cost is the state wide average buried trenching cost from the PLAN/ESM cost deck and includes trenching, cut and replace, all restoration, engineering, travel time, etc.

4) The $2.00 for the one 4" duct is the inplace cost and includes material costs as well as the labor for placing the duct in the trench,

5) The $2.50 for handholes is the inplace cost and includes material costs as well as labor for placing ($1500 @ spaced at 600 feet).

COST PROXY MODEL

MODIFYING FACTORS
UG COPPER AND FIBER (FEEDER AND DISTRIBUTION)
FRCs 5C AND 85C

DENSITY	ALL TERRAINS
0-10	1.00
11-50	1.00
51-150	1.00
151-500	1.00
501-2000	1.10
2001-5000	1.20
5001+	1.40

ASSUMPTIONS

1) These factors modified the "A Cost" and "B Cost" by density zone.
- Spotting of material in the less dense zones can be close to the work location. In denser areas, finding suitable areas close to the work location is difficult.
- Heavier traffic which requires lane controls and well guarded work location is more frequently encountered in more dense areas.
- Underground vaults are larger in denser areas thus pumping water out of vaults takes longer
- Work hour restrictions are necessary in denser areas due traffic congestion at commute hours. Its not uncommon to work nights due to city rules.

2) The placing of underground copper and fiber cables in conduit is impacted more by conditions caused by density than terrain

COST PROXY MODEL

MODIFYING FACTORS
AERIAL COPPER AND FIBER (FEEDER AND DISTRIBUTION)
FRCs 12C AND 812C

DENSITY	ALL TERRAIN
0-10	1.00
11-50	1.00
51-150	1.00
151-500	1.00
501-2000	1.10
2001-5000	1.20
5001+	1.40

ASSUMPTIONS

1) These factors modified the "A Cost" and "B Cost" by density zone.
- Spotting of material in the less dense zones can be close to the work location. In denser areas, finding suitable areas close to the work location is difficult.
- Heavier traffic which requires lane controls and well guarded work location is more frequently encountered in more dense areas.
- Work hour restrictions are necessary in denser areas due traffic congestion at commute hours. Its not uncommon to work nights due to city rules.
- In denser areas street crossings require more traffic control.

2) The placing of aerial copper and fiber cables on poles is impacted more by conditions caused by density than terrain

MODIFYING FACTORS
BURIED COPPER AND FIBER (FEEDER AND DISTRIBUTION)
FRCs 45C AND 845C

DENSITY	NORMAL	MED-DIF (ROCKS)	HIGH-DIF (ROCKH)	WATER
0-10	0.80	1.17	1.50	1.50
11-50	0.90	1.26	1.51	1.51
51-150	1.00	1.24	1.45	1.45
151-500	1.00	1.27	1.55	1.55
501-2000	1.00	1.34	1.67	1.67
2001-5000	1.10	1.38	1.68	1.68
5001+	1.20	1.56	1.98	1.98

ASSUMPTIONS

1) These factors modified the "A Cost" and "B Cost" by density zone.
- Spotting of material in the less dense zones can be close to the work location. In denser areas, finding suitable areas close to the work location is difficult.
- Heavier traffic which requires lane controls and well guarded work location is more frequently encountered in more dense areas.
- Work hour restrictions are necessary in denser areas due traffic congestion at commute hours. Its not uncommon to work nights due to city rules.
- In denser areas street crossings require more traffic control and restrict the footage of open trench available at a time.
- Denser areas will require more repaving cost
- Denser areas have much more substructure congestion (water, gas, sewer etc.)
- Rocks and water increases labor proportional to the amount of water and the amount and size of the rocks.

COST PROXY MODEL

TERMINALS - INVESTMENTS PER LINE

	TERMINAL $		TERMINAL MIX		AVG INVEST	% 1 & 2	AVG INVEST
	BURIED	AERIAL	BURIED	AERIAL	SUB TOTAL	LIV.UNIT	SINGLE FAM.
	A	B	C	D	E	F	G
DENSITY					(A*C)+(B*D)		E * F
0 - 10	$ 347.72	$ 188.48	60%	40%	$ 284.02	91%	**$ 258.46**
11 - 50	$ 311.51	$ 166.89	63%	37%	$ 258.00	90%	**$ 232.20**
51 - 150	$ 243.03	$ 129.41	70%	30%	$ 208.94	86%	**$ 179.69**
151 - 500	$ 176.24	$ 93.27	70%	30%	$ 151.35	80%	**$ 121.08**
501 - 2000	$ 85.86	$ 45.44	85%	15%	$ 79.80	74%	**$ 59.05**
2001-5000	$ 56.28	$ 29.78	95%	5%	$ 54.96	68%	**$ 37.37**
5000+	$ 33.49	$ 17.72	98%	2%	$ 33.17	47%	**$ 15.59**

ASSUMPTIONS

1) Consolidation of construction garages adds to travel time in all zones.
   a. Rural areas due to distance traveled.
   b. Urban areas due to freeways and traffic congestion.

2) % ADL SOURCE - PARIS/FIMS

3) % SINGLE FAMILY SOURCE - 1990 CENSUS

4) MATL. COST SOURCE - NOVA

5) AERIAL/BURIED MIX BASED ON FORWARD LOOKING PLANT

COST PROXY MODEL

DROP INVESTMENT PER LINE

	TERMINAL $		TERMINAL MIX		AVG INVES	% 1 & 2	AVG INVEST
	BURIED	AERIAL	BURIED	AERIAL	SUB TOTA	LIV.UNIT	SINGLE FAM.
	A	B	C	D	E	F	G
DENSITY					(A*C)+(B*D)		E * F
0 - 10	$ 183.85	$ 171.75	60%	40%	$ 179.01	91%	$ 162.90
11 - 50	$ 182.16	$ 172.32	63%	37%	$ 178.52	90%	$ 160.67
51 - 150	$ 169.76	$ 163.32	70%	30%	$ 167.83	86%	$ 144.33
151 - 500	$ 114.04	$ 115.08	70%	30%	$ 114.35	80%	$ 91.48
501 - 2000	$ 67.63	$ 73.56	85%	15%	$ 68.52	74%	$ 50.71
2001-5000	$ 66.50	$ 74.13	95%	5%	$ 66.88	68%	$ 45.48
5000+	$ 55.34	$ 63.62	98%	2%	$ 55.51	47%	$ 26.09

ASSUMPTIONS

1) LONGER DROP LENGTHS AS DENSITY DECREASES

2) LABOR HOURS INCLUDE COST OF DROP TERMINATION, TRAFFIC CONTROL IN DENSE AREAS HOUSE ATTACH. AND SNI TERMINATION.

3) % ADL SOURCE - PARIS/FIMS

4) % SINGLE FAMILY SOURCE - 1990 CENSUS

5) MATL. COST SOURCE - NOVA

6) AERIAL/BURIED MIX BASED ON FORWARD LOOKING PLANT

COST PROXY MODEL

SERVING AREA INTERFACE (SAI)
(AND CROSS CONNECTS)

INVESTMENT PER LINE

DENSITY	SAI $	% SAI	$ PER LN	BLDG $	% BLDG.	$ PER LN	X CONN $	% X CONN	$ PER LN	TOTAL $
	A	B	C=AxB	D	E	F=DxE	G	H	I=GxH	J=C+F+I
0 - 10	$ 57.14	5%	$ 2.86	$ 75.85	8%	$ 6.07	$ 81.40	87%	$ 70.82	**$ 79.74**
11 - 50	$ 45.71	25%	$ 11.43	$ 39.48	10%	$ 3.95	$ 75.40	65%	$ 49.01	**$ 64.39**
51 - 150	$ 38.09	50%	$ 19.05	$ 28.88	14%	$ 4.04	$ 31.40	36%	$ 11.30	**$ 34.39**
151 - 500	$ 21.16	80%	$ 16.93	$ 23.58	20%	$ 4.72	$ -	0%	N/A	**$ 21.65**
501 - 2000	$ 21.16	74%	$ 15.66	$ 18.65	26%	$ 4.85	$ -	0%	N/A	**$ 20.51**
2001 - 5000	$ 21.16	68%	$ 14.39	$ 18.57	32%	$ 5.94	$ -	0%	N/A	**$ 20.33**
> 5000	$ 17.25	47%	$ 8.11	$ 18.52	53%	$ 9.82	$ -	0%	N/A	**$ 17.92**

ASSUMPTIONS

1) % USE OF DIFFERENT TYPES OF X-CONN DIFFERS BY DENSITY ZONE

2) % MIX OF BLDG TERM PER DENSITY ZONE IS FROM 1990 CENSUS SINGLE FAMILY / MULTI-FAMILY

3) % USE OF SAI/X-CONN IN DENSITY ZONES DEVELOPED BY A PANEL OF SUBJECT MATTER EXPERTS

COST PROXY MODEL

PAIR GAIN EQUIPMENT INVESTMENTS - FRC 257C (DIGITAL LOOP CARRIER)

DENSITY	FIXED $ PER LOC	VARIABLE $ PER PR	CHAN. CAP.
0-10	27800	121	24
11-50	34800	271	96
51-150	34800	271	96
151-500	115000	125	672
501-2000	115000	125	672
2001-5000	140000	125	1344
5001+	140000	125	1344

SAMPLE INVESTMENT DEVELOPMENT

ONU - 24

RT INCLUDING CABINET	$15,000	
CO HDFB	$2,000	
CO OPTICAL LINE UNIT	$800	
MISC *	$10,000	
RT PLUG-IN	$2,400	
COT PLUG-IN	$500	
TOTAL	$30,700	
FIXED	$27,800	
VARIABLE	$2,900	(plug-ins)

ONU - 96

RT INCLUDING CABINET	$20,000
CO HDFB	$2,000
CO OPTICAL LINE UNIT	$800
MISC *	$12,000
RT PLUG-IN	$24,000
COT PLUG-IN	$2,000
TOTAL	$60,800
FIXED	$34,800
VARIABLE	$26,000

LITESPAN 2000 - 672 capacity

RT INCLUDING CABINET	$75,000	
MISC *	$25,000	
COT	$15,000	
RT PLUG-IN	$67,200	
COT PLUG-IN	$16,800	
TOTAL	$199,000	
FIXED	$115,000	
VARIABLE	$84,000	(plug-ins)

LITESPAN 2000 - 1344 capacity

RT INCLUDING CABINET	$100,000
MISC *	$25,000
COT	$15,000
RT PLUG-IN	$134,400
COT PLUG-IN	$33,600
TOTAL	$308,000
FIXED	$140,000
VARIABLE	$168,000

* MISC INCLUDES BATTERIES, AC POWER, PED MOUNT, PAD, PROTECTORS, R/W, & SPLICING

NOTE : THE NUMBERS SHOWN ARE NOT REAL INVESTMENTS WHICH ARE PROPRIETARY INFORMATION. THESE NUMBERS ARE ONLY INTENTED TO DEMONSTRATE THE METHOD.

% FEEDER

DENSITY	DISTANCE FROM C.O. 0-9 KFT	9-15 KFT	15-24 KFT	24 KFT+
0-10	64%	60%	67%	82%
10-50	64%	60%	67%	82%
50-150	64%	60%	73%	85%
150-500	64%	73%	86%	92%
500-2000	68%	83%	89%	90%
2000-5000	77%	85%	89%	93%
5000+	85%	89%	93%	93%

This table is used to determine the feeder and distribution lengths when data is not available in existing data bases.

The % feeder table was developed from the 1254 loop samples taken in 1995 for the OANAD study. The cable and pair data was sorted by density zone and distance from the wire center. In those cases where there were no loops for a distance within a density zone, engineering judgment was used to arrive at the appropriate split.

COST PROXY MODEL

FORMULAS FOR INVESTMENT CALCULATIONS

The purpose of Page 15.0 and 15.1 is to demonstrate the calculations used in developing the investment for the Outside Plant used in provisioning a local loop. In order to demonstrate these calculations it is necessary to establish the "A Cost" and "B Cost" for the cables. Since Pacific Bell's material costs are proprietary, dummy costs will be used:

TYPE OF CABLE	FRC	A COST $ / Sheath-foot	B COST $ / Pair-foot
Copper Underground Cable	5C	3.00	0.0100
Copper Buried Cable	45C	7.00	0.0100
Copper Aerial Cable	12C	3.00	0.0100
Fiber Underground Cable	85C	2.00	0.0600
Fiber Buried Cable	845C	8.00	0.0600
Fiber Aerial Cable	812C	2.00	0.0600

For this demonstraction only A and B costs for one copper and one fiber cable is required in each formula. Nomally each formula would be used for each type of cable.

For demonstraction purposes dummy cable sizes, modification factors, utilization percentages, pole line cost, conduit costs, and number of channels will also be used:

Copper Cable Size	550 pairs	Fiber Cable Size	48 fibers
Modification Factor	1.10	Cable Utilization	75%
Number of Channels	672	Equipment Utilization	80%
Pole Line Cost per Foot	4.02	Conduit Cost per Duct-Foot	12.00

The length for all calculation will be 1000 feet. In the model the length would be calculated by multipling the feeder or distribution length by the appropriate % mix from the appropriate density zone to determine the cable length for each type of cable (underground, buried and aerial). In the calculation for fiber cables "4 Fibers" is multiplied

In the calculation for fiber cables, the cable size is multiplied by "4 Fibers". The calculation is required to reflect the 4 fibers used for each digital loop carrier system (two working fibers and two protection fibers).

COST PROXY MODEL

FORMULAS FOR CALCULATING THE INVESTMENT PER LOOP

COPPER CABLES - FRCs 5C, 12C, & 45C

(use Buried Copper Cable - 45C)

Length x [(A-Cost + (B-Cost x Cable Size)) / Cable Size / Cable Utilization x Modifying Factor]

1000 x [(7.00 + (.0100 x 550)) / 550 /.75 x 1.10] = 33.33

FIBER CABLES - FRCs 85C, 812C, & 845C

(use Aerial Fiber Cable - 812C)

Length x{[((A-Cost + (B-Cost x Cable Size)) / Cable Size) x 4 Fibers / Cable Utilization x Modifying Factor] / (# of Channels x Equipment Utilization)}

1000 x {[((2.00 + (.0600 x 48)) / 48) x 4 / 75 x 1.10] / (672 x .80)} = 1.11

POLE LINE INVESTMENT - FRC 1C FOR COPPER CABLES

FEEDER	DISTRIBUTION
Length x (Pole Line / Cable Size / Cable Utilization) x 2nd Cable Factor	Length x (Pole Line / Cable Size / Cable Utilization)
1000 x (4.02 / 550 / .75) x .80 = 7.80	1000 x (4.02 / 550 / .75) = 9.75

POLE LINE INVESTMENT - FRC 1C FOR FIBER CABLES

Length x [((Pole Line / Cable Size) x 4 Fibers / Cable Utilization)) / (Channels x Equipment Utilization)]

1000 x [((4.02 / 48) x 4 / 75) / (672 x .80)] = .83

CONDUIT INVESTMENT - FRC 4C FOR COPPER CABLES

Length x (Conduit / Cable Size / Cable Utilization)

1000 x (12.00 / 550 / 75) = 29.09

CONDUIT INVESTMENT - FRC 4C FOR FIBER CABLES

Length x [((Conduit / Cable Size) x 4 Fibers / Cable Utilization) / (Channels x Equipment Utilization)] / 3

1000 x [((12.00 / 48) x 4 / 75) / (672 x .80)] /3 = .83

COST PROXY MODEL

HOW THE INVESTMENTS ARE CALCULATED FOR THE LOCAL LOOP

The purpose of this handout is to provide examples of how the COST PROXY MODEL calculates the investments for the local loop. In order to provide this example, the "A and B Costs" for cables must be shown. Since Pacific Bell's A and B Costs are considered proprietary, dummy A and B Costs will be used for these examples :

UNIT DESCRIPTION	FRC (Field Reporting Code)	A COST ($ / SH-FT)	B COST ($ / PR-FT or FIBER-FT)
COPPER UNDERGROUND CABLE	5C	3.00	0.0100
COPPER BURIED CABLE	45C	7.00*	0.0100
COPPER AERIAL CABLE	12C	3.00	0.0100
FIBER UNDERGROUND CABLE	85C	2.00	0.0600
FIBER BURIED CABLE	845C	8.00*	0.0600
FIBER AERIAL CABLE	812C	2.00	0.0600

* Includes trenching cost

In addition to these unit investments, all the unit investments and modifying factors from the Cost Proxy Model package will be used. When an unit investment or factor from that package is used, the page number (PAGE 1.0) is shown for the table the investment or factor was taken from.

Typical customer record for a loop with feeder length UNDER 9000 feet (data contained in the record but not related to these calculations was omitted for clarity)

DISTRIBUTION

CLASS OF SERVICE	WIRE CENTER (CLLI)	SAI (TAPER CODE #)	CBG	DISTRIBUTIO DISTANCE	CUSTOMER LATITUDE	CUSTOMER LONGITUDE	SAI LATITUDE	SAI LONGITUDE	DIST. DENSITY	DIST. TERRAIN
1FR	PLMOCA11	210201	6050002004	1299	38.46	-120.81	38.47	-120.82	Z2	M

The first step made in the model is to determine the distribution cable lengths by technology (UG, buried, and aerial). To accomplish this the model uses the "DISTRIBUTION DISTANCE" and the % MIX for distribution from the table on PAGE 1.0. The model uses the "DIST DENSITY" (Z2 = Density 11 - 50) to determine which % mix to use from that table. The "DIST DENSITY" is also used to select the average distribution cable sizes from PAGE 2.0, the level of utilization from PAGE 3.0, and combined with the "DIST TERRAIN" (M = Medium Difficulty) it selects the modifying factor for terrain for each technology from PAGES 7.0, 8.0, and 9.0.

LENGTH OF DISTRIBUTION BY TECHNOLOGY

TYPE OF CABLE	DIST. LENGTH	% MIX (PAGE 1.0)	LENGTHS	AVERAGE DISTRIBUTION CABLE SIZE (PAGE 2.0)	AVERAGE DISTRIBUTION UTILIZATION % (PAGE 3.0)	MODIFYING FACTOR (PAGE 7.0, 8.0, & 9.0)
UNDERGROUND	1299	3%	39 Feet	243 Pairs	36%	1.00
BURIED	1299	60%	779 Feet	298 Pairs	36%	1.26
AERIAL	1299	37%	481 Feet	201 Pairs	36%	1.00

COST PROXY MODEL

The investments for distribution cables are calculated using these numbers:

TYPE OF CABLE	FORMULA	Length x [(A-Cost + (B-Cost x Cable Size)) / Cable Size / Cable Utilization x Modifying Factor]
UNDERGROUND		39 feet x ((3.00 + (.0100 x 243 pairs)) / 243 pairs / 36% x 1.00) = $2.42
BURIED		779 feet x ((7.00 + (.0100 x 298 pairs)) / 298 pairs / 36% x 1.26) = $91.31
AERIAL		481 feet x ((3.00 + (.0100 x 201 pairs)) / 201 pairs / 36% x 1.00) = $33.30

The investments for supporting structure are calculated using the cable lengths of the technology requiring the structure. Conduit uses the length of underground cable and pole line uses the aerial cable length. The model uses the "DIST DENSITY" (Z2 = Density 11 - 50) and the "DIST TERRAIN" (M = Medium Difficulty) to determine which structure unit investments to use from PAGE 4.0 (Pole Line) and PAGE 6.2 (Conduit for Distribution). These investments are multiplied by the length and then divided by the cable size and cable utilization to develop the structure investment per pair-foot.

Pole Line Unit Investment (PAGE 4.0) = $4.96 Conduit Unit Investment (PAGE 6.2) = $9.50

TYPE OF STRUCTURE	FORMULA	
	FORMULA	Length x (Pole Line / Cable Size / Cable Utilization)
	FORMULA	Length x (Conduit / Cable Size / Cable Utilization)
POLE LINE		481 feet x (4.96 / 201 pairs / 36%) = $32.97
CONDUIT		39 feet x (9.50 / 243 pairs / 36%) = $4.24

The final investments to be determined for the distribution are the terminal and service drop investments. These investments are not calculated in the model, they're taken right off the tables on PAGE 10.0 (Terminals) and PAGE 11.0 (Drops) using the density zone for distribution.

Terminal Investment (Density 11 - 50) = $232.20 Service Drop Investment (Density 11 -50) = $160.67

FEEDER

The investments for copper feeder cables and their supporting structure are calculated in a similar manner using the data from the customer record pertaining to the feeder plant.

CLASS OF SERVICE	WIRE CENTER (CLLI)	SAI (TAPER CODE #)	CBG	FEEDER DISTANCE	WIRE CENTER LATITUDE	WIRE CENTER LONGITUDE	SAI LATITUDE	SAI LONGITUDE	FEEDER DENSITY	FEEDER TERRAIN
1FR	PLMOCA11	210201	6050002004	6300	38.48	-120.84	38.47	-120.82	Z2	M

LENGTH OF COPPER FEEDER BY TECHNOLOGY

TYPE OF CABLE	FEEDER LENGTH	% MIX (PAGE 1.0)	LENGTHS	AVERAGE COPPER FEEDER CABLE SIZE (PAGE 2.0)	AVERAGE COPPER FEEDER UTILIZATION % (PAGE 3.0)	MODIFYING FACTOR (PAGE 7.0, 8.0, & 9.0)
UNDERGROUND	6300	39%	2457 Feet	952 Pairs	59%	1.00
BURIED	6300	16%	1008 Feet	182 Pairs	59%	1.26
AERIAL	6300	45%	2835 Feet	248 Pairs	59%	1.00

COST PROXY MODEL

The investments for copper feeder cables are calculated using these numbers:

TYPE OF CABLE	FORMULA	Length x [(A-Cost + (B-Cost x Cable Size)) / Cable Size / Cable Utilization x Modifying Factor]
UNDERGROUND		2457 feet x ((3.00 + (.0100 x 952 pairs)) / 952 pairs / 59% x 1.00) = $54.77
BURIED		1008 feet x ((7.00 + (.0100 x 182 pairs)) / 182 pairs / 59% x 1.26) = $104.32
AERIAL		2835 feet x ((3.00 + (.0100 x 248 pairs)) / 248 pairs / 59% x 1.00) = $106.18

Pole Line Unit Investment (PAGE 4.2) = $4.91 Conduit Unit Investment (PAGE 5.0) = $20.25

TYPE OF STRUCTURE	FORMULA	Length x (Pole Line / Cable Size / Cable Utilization)
	FORMULA	Length x (Conduit / Cable Size / Cable Utilization)
POLE LINE		2835 feet x (4.91 / 248 pairs / 59%) = $95.13
CONDUIT		2457 feet x (20.25 / 952 pairs / 59%) = $88.58

The final investment for the feeder is the SAI (Serving Area Interface) and is obtained directly from the table on PAGE 12.0.

SAI Investment (Density 11 - 50) = $64.39

SUMMARY OF OUTSIDE PLANT INVESTMENTS

	Description of Plant	Units	Investment
Distribution Plant			
	Underground Copper Cable	39	$2.42
	Buried Copper Cable	779	$91.31
	Aerial Copper Cable	481	$33.30
	Pole Line	481	$32.97
	Conduit	39	$4.24
	Terminal	1	$232.20
	Service Drop	1	$160.67
		Total Distribution	$557.11
Feeder Plant			
	Underground Copper Cable	2457	$54.77
	Buried Copper Cable	1008	$104.32
	Aerial Copper Cable	2835	$106.18
	Pole Line	2835	$95.13
	Conduit	2457	$88.58
	SAI	1	$64.39
		Total Feeder	$513.37

TOTAL LOOP (< 9000") $1,070.48

COST PROXY MODEL

Typical customer record for a loop with feeder length OVER 9000 feet (data contained in the record but not related to these calculations was omitted for clarity)

CLASS OF SERVICE	WIRE CENTER (CLLI)	SAI (TAPER CODE #)	CBG	DISTRIB. DISTANCE	CUSTOMER LATITUDE	CUSTOMER LONGITUDE	SAI LATITUDE	SAI LONGITUDE	DIST. DENSITY	DIST. TERRAIN
1FR	STCKCA11	210701	6050002006	4622	38.41	-120.76	38.41	-120.78	Z2	M

The first step made in the model is to determine the distribution cable lengths by technology (UG, buried, and aerial). To accomplish this the model uses the "DISTRIBUTION DISTANCE" and the % MIX for distribution from the table on PAGE 1.0. The model uses the "DIST DENSITY" (Z2 = Density 11 - 50) to determine which % mix to use from that table. The "DIST DENSITY" is also used to select the average distribution cable sizes from PAGE 2.0, the level of utilization from PAGE 3.0, and combined with the "DIST TERRAIN" (M = Medium Difficulty) it selects the modifying factor for terrain for each technology from PAGES 7.0, 8.0, and 9.0.

LENGTH OF DISTRIBUTION BY TECHNOLOGY

TYPE OF CABLE	DIST. LENGTH	% MIX (PAGE 1.0)	LENGTHS	AVERAGE DISTRIBUTION CABLE SIZE (PAGE 2.0)	AVERAGE DISTRIBUTION UTILIZATION % (PAGE 3.0)	MODIFYING FACTOR (PAGE 7.0, 8.0, & 9.0)
UNDERGROUND	4622	3%	139 Feet	243 Pairs	36%	1.00
BURIED	4622	60%	2773 Feet	298 Pairs	36%	1.26
AERIAL	4622	37%	1710 Feet	201 Pairs	36%	1.00

The investments for distribution cables are calculated using these numbers:

TYPE OF CABLE	FORMULA	Length x [(A-Cost + (B-Cost x Cable Size)) / Cable Size / Cable Utilization x Modifying Factor]
UNDERGROUND		139 feet x ((3.00 + (.0100 x 243 pairs)) / 243 pairs / 36% x 1.00) = $8.63
BURIED		2773 feet x ((7.00 + (.0100 x 298 pairs)) / 298 pairs / 36% x 1.26) = $325.04
AERIAL		1710 feet x ((3.00 + (.0100 x 201 pairs)) / 201 pairs / 36% x 1.00) = $118.40

The investments for supporting structure are calculated using the cable lengths of the technology requiring the structure. Conduit uses the length of underground cable and pole line uses the aerial cable length. The model uses the "DIST DENSITY" (Z2 = Density 11 - 50) and the "DIST TERRAIN" (M = Medium Difficulty) to determine which structure unit investments to use from PAGE 4.0 (Pole Line) and PAGE 6.2 (Conduit for Distribution). These investments are multiplied by the length and then divided by the cable size and cable utilization to develop the structure investment per pair-foot.

Pole Line Unit Investment (PAGE 4.0) = $4.96 Conduit Unit Investment (PAGE 6.2) = $9.50

TYPE OF STRUCTURE		
	FORMULA	Length x (Pole Line / Cable Size / Cable Utilization)
	FORMULA	Length x (Conduit / Cable Size / Cable Utilization)
POLE LINE		1710 feet x (4.96 / 201 pairs / 36%) = $117.21
CONDUIT		139 feet x (9.50 / 243 pairs / 36%) = $15.09

COST PROXY MODEL

The final investments to be determined for the distribution are the terminal and service drop investments. These investments are not calculated in the model, they're taken right off the tables on PAGE 10.0 (Terminals) and PAGE 11.0 (Drops) using the density zone for distribution.

Terminal Investment (Density 11 - 50) = $232.20 Service Drop Investment (Density 11 -50) = $160.67

Since the feeder portion of this loop is OVER 9000, the investments are based on fiber feeder cables. The investments for fiber cables and their supporting structure are calculated in a similar manner using the data from the customer record pertaining to the feeder plant.

CLASS OF SERVICE	WIRE CENTER (CLLI)	SAI (TAPER CODE #)	CBG	FEEDER DISTANCE	WIRE CENTER LATITUDE	WIRE CENTER LONGITUDE	SAI LATITUDE	SAI LONGITUDE	FEEDER DENSITY	FEEDER TERRAIN
1FR	STCKCA11	210701	6050002006	15400	38.41	-120.78	38.4	-121.73	Z3	M

Note: The FEEDER DENSITY for this loop is different from the distribution density (Z3 = Density 51 - 150).

LENGTH OF FIBER FEEDER BY TECHNOLOGY

TYPE OF CABLE	FEEDER LENGTH	% MIX (PAGE 1.0)	LENGTHS	AVERAGE FIBER CABLE CABLE SIZE (PAGE 2.0)	AVERAGE FIBER CABLE UTILIZATION % (PAGE 3.0)	MODIFYING FACTOR (PAGE 7.0, 8.0, & 9.0)
UNDERGROUND	15400	66%	10164 Feet	48 Fibers	67%	1.00
BURIED	15400	7%	1078 Feet	48 Fibers	67%	1.24
AERIAL	15400	27%	4158 Feet	24 Fibers	67%	1.00

The investments for fiber feeder cables are calculated using these numbers plus the "EQUIPMENT UTILIZATION" (PAGE 3.0) and the "CHANNEL CAPACITY" (PAGE 13.0):

Pair-Gain Equipment Utilization = 71%
Channel Capacity of Equipment = 96

TYPE OF CABLE		
	FORMULA	Length x{[((A-Cost + (B-Cost x Cable Size)) / Cable Size) x 4 Fibers / Cable Utilization x Modifying Factor] / (# of Channels x Equipment Utilization)}
UNDERGROUND		10164 x {[((2.00 + (.0600 x 48)) / 48) x 4 / .67 x 1.00] / (96 x .71)} = $90.51
BURIED		1078 x {[((8.00 + (.0600 x 48)) / 48) x 4 / .67 x 1.24] / (96 x .71)} = $26.54
AERIAL		4158 x {[((2.00 + (.0600 x 24)) / 24) x 4 / .67 x 1.00] / (96 x .71)} = $87.00

Pole Line Unit Investment (PAGE 4.2) = $5.53

Conduit Unit Investment <9000 ft.(PAGE 5.0) = $24.48
Conduit Unit Investment >9000 ft.(PAGE 6.0) = $35.65

TYPE OF STRUCTURE		
	FORMULA	Length x [((Pole Line / Cable Size) x 4 Fibers / Cable Utilization)) / (# of Channels x Equipment Utilization)]
	FORMULA	Length x [((Conduit / Cable Size) x 4 Fibers / Cable Utilization) / (# of Channels x Equipment Utilization)] / 3 Innerducts Per Duct
POLE LINE		4158 x [((5.53 / 24) x 4 / .67) / (96 x .71)] = $83.92
CONDUIT	<9000 ft	9000 x [((24.48 / 48) x 4 / .67) / (96 x .71)] / 3 = $134.01
	>9000 ft.	(10164-9000) x [((35.65 / 48) x 4 / .67) / (96 x .71)] / 3 = $25.24

THE COST PROXY MODEL©

BLOCK DIAGRAMS

COST PROXY MODEL OVERVIEW